



United States Department of Agriculture  
Animal and Plant Health Inspection Service  
Plant Protection and Quarantine



Importation of Chinese Penjing  
into the United States  
With Particular Reference to  
*Buxus sinica*

2003 Supplement

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## Executive Summary

This pathway-initiated commodity risk assessment examines the risks associated with the proposed importation of penjing plants of *Buxus sinica*, in APHIS-approved growing media, from the People's Republic of China into the United States. The quarantine pests that are likely to follow the pathway are analyzed using the methodology described in the USDA, APHIS, PPQ Guidelines 5.02 which examines pest biology in the context of the Consequences of Introduction and the Likelihood of Introduction and estimates the Pest Risk Potential. There are quarantine pests that can potentially follow the pathway on these plants. The pests include 17 arthropods, two mollusks and four fungi. The Pest Risk Potential for all of the arthropod and mollusk pests is High, and the Pest Risk Potential for the fungal pathogens is Medium.

Summary of the Consequences of Introduction, the Likelihood of Introduction and Pest Risk Potential.	
Pest	Pest Risk Potential
<b>ARTHROPODA</b> <b>Scarabaeidae</b> <i>Anomala cupripes</i> <i>Sympiezomias velatus</i>  <b>Homoptera</b> <i>Aleurotuberculatus hikosanensis</i> <i>Ceroplastes japonicus</i> <i>C. pseudoceriferus</i> <i>Lycorma delicatula</i> <i>Parlagena buxi</i> <i>Ricania sublimbata</i> <i>Unaspis yanonensis</i>  <b>Lepidoptera</b> <i>Ascotis selenaria</i> <i>Clania minuscula</i> <i>Cryptothoelea variegata</i> <i>Pryeria sinica</i> <i>Thosea sinensis</i> <i>Zeuzera coffeae</i>  <b>Orthoptera</b> <i>Tridactylus japonicus</i>	   High (29) High (28)     High (28) High (30) High (30) High (27) High (29) High (30) High (28)    High (30) High (30) High (30) High (29) High (28) High (30)   High (30)
<b>MOLLUSCA</b> <i>Acusta ravida</i> <i>Succinea horticola</i>	  High (31) High (31)
<b>FUNGI</b> <i>Guignardia miribelii</i> <i>Macrophoma ehretia</i> <i>Meliola buxicola</i> <i>Puccinia buxi</i>	  Medium (25) Medium (26) Medium (25)

Summary of the Consequences of Introduction, the Likelihood of Introduction and Pest Risk Potential.	
Pest	Pest Risk Potential
	Medium (26)

A number of exotic, polyphagous insects, analyzed in 1996 using the PPQ Guidelines version 4.0 criteria and then current literature, assumed that pests intercepted in Europe, on unspecified bonsai plants could be pests of *B. sinica* (EPPO, 1996a, b). The following pests are now not considered likely to follow the pathway of the importation based on a reexamination of their reported host ranges: *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *Aporia crataegi*, *Atractomorpha sinensis*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis* (*G. africana* or *G. africans*), *Helicoverpa armigera*, *H. assulta*, *Icerya aegyptica*, *Lepidosaphes laterochitinsa*, *Mamestra brassicae*, *Phyllophaga titanis*, and *Spodoptera litura* (China, 1995). Similarly, *Hymenia perspectalis*, present in the United States, is not analyzed.

The accompanying pest risk management document considers the reduction of risk that will occur when existing regulations on the importation of plants in APHIS-approved growing media (7 CFR ' 319.37-8) and proposed additional mitigation measures are applied to the importation of *B. sinica* penjing plants in growing media from the People's Republic of China. The safeguards, presented in a separate risk mitigation document, will effectively remove the pests of concern from the pathway and allow the importation of these plants to be associated with no more pest risk than is associated with currently permitted bare-root importations.

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## **I. Introduction**

This pest risk assessment (PRA) was conducted by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, Center for Plant Health Science and Technology, Plant Epidemiology and Risk Analysis Laboratory (USDA, APHIS, PPQ, CPHST, PERAL) to examine the plant pest risks associated with the importation of artificially dwarfed plants of *Buxus sinica* established in an APHIS-approved growing medium from the People's Republic of China into the United States. The purpose of this document is to update an earlier version (Cave and Redlin, 1996).

The art of artificially dwarfing plants is a time-consuming and highly labor-intensive activity. The resulting plants range from approximately four inches to 60 inches in height, and the value may range from \$10 to \$10,000 per plant. The median price of an artificially dwarfed plant is close to \$100 and varies with the age of the plant regardless of size. Plants imported from Asia (Japan, the People's Republic of China and the Republic of Korea) represent approximately 80 percent of the value of the entire artificially dwarfed plant market in the United States (Importation of Artificially Dwarfed Plants in Growing Media From the People's Republic of China, 65 Fed. Reg. 56803-56806 (2000) (as proposed Sept. 20, 2000) (Docket Number: 98-103-1)).

The Authority for APHIS to regulate plant pests and plant products is derived from the Plant Protection Act of 2000 (7 USC ' ' 7701 *et seq.*) and the Code of Federal Regulations, Title 7, Part 319, Subpart 37 (7 CFR ' 319.37 - Nursery Stock, Plants, Roots, Bulbs, Seeds and Other Plant Products). The risk assessment methodology, rating criteria and the use of biological and phytosanitary terms is consistent with international guidelines (FAO, 2001, 2002; NAPPO, 1995) and current agency guidelines (APHIS, 2000).

## **II. Risk Assessment**

### **A. Initiating Event: Proposed Action**

This commodity-based, pathway-initiated pest risk assessment is prepared in response to a request from the Chinese Animal and Plant Quarantine Service (ASIQ) to change current regulations to allow increased types of importations of artificially dwarfed penjing plants of *Buxus sinica*, in approved growing media, from China into the United States. This is a potential pathway for the introduction of plant pests. The entry of *B. sinica* from China into the United States is currently regulated under 7 CFR ' 319.37, and does not explicitly prohibit the importation of naturally dwarf plants under 305 millimeters in length or artificially dwarfed plants. This lack of restrictions allows such plants to enter the United States if the plants are accompanied by a phytosanitary certificate of inspection.

In general, the USDA carefully assesses requests to change regulations related to propagative materials because the importation of propagative material in growing media raises unique phytosanitary concerns. Specifically, biological contaminants may not be discernible during pre-shipment and Port of Entry visual inspections. This inability to non-destructively inspect all parts of the plants, may increase the potential for the introduction of exotic organisms. Treatment of growing

media may not rid the media of organisms in the absence of specific guidelines, and the possibility of pest infestation/re-infestation of clean plants in the absence of specific safeguards exists.

During the past decade, China has exported significant volumes of bare-root bonsai plants into the United States under the existing regulations. In August 1992, representatives of the China Animal and Plant Quarantine Service (ASIQ) requested permission to export penjing plants (bonsai established in growing media) in APHIS-approved growing media. A list of 112 plant species was submitted. These plants were categorized by PPQ as Prohibited, Apost-entry quarantine and Restricted. In January 1994, the Chinese government was asked to select five species for pest risk analysis. Subsequently, a list of eight species and a list of pests or potential pests associated with these plants was provided to PPQ. In April 1994, PPQ staff identified five plant species as candidates for pest risk assessments: *Buxus sinica* (Buxaceae), *Ehretia (Carmona) microphylla* (Boraginaceae), *Podocarpus macrophyllus* (Podocarpaceae), *Sageretia thea (theazans)* (Rhamnaceae), and *Serissa foetida* (Rubiaceae). The risk assessment for *B. sinica* was completed in September 1996 using agency guidelines 4.0 (APHIS, 1995). A Proposed Rule was published in 65 Fed. Reg 183 (Docket Number 00-042-1) on September 20, 2000. Compliance with the Endangered Species Act necessitated PPQ consultation with the US Fish and Wildlife Service (USFWS). Additional documentation was provided separately to the USFWS. These documentary requirements created a need to re-examine and update the original risk assessment for *B. sinica*.

The Final Rule was designed to reduce the risks associated with field-collected plants that are produced quickly in their country of origin for mass export [Importation of Artificially Dwarfed Plants 67 Fed. Reg. 53727-53731 (2002) (Docket No. 00-042-2)]. These field-grown plants include species that, historically, were not imported as artificially dwarfed plants and that may not be given the same meticulous care and safeguards as traditional artificially dwarfed plants. The rule also requires that the plants are grown for at least two years in a greenhouse or screen-house in approved nurseries that are inspected annually, and that phytosanitary certificates accompany the plants. Artificially dwarfed plants grown in fields prior to their 2-year greenhouse/screen-house growth period are required to be produced with specific safeguards to protect against infestation by longhorned beetles (Coleoptera: Cerambycidae).

The artificially dwarfed plants proposed for export are in the plant family, Buxaceae. This family includes the genera: *Buxus*, *Pachysandra*, *Sarcococca*, *Simmondsia*, and *Styloceras*. Members of this family include approximately 70 species that are evergreen shrubs, trees or perennial herbs (Bailey *et al.*, 1976; Mabberly, 1997). In the United States, they are widely distributed in temperate and subtropical regions, and grown as ornamentals (Bailey *et al.*, 1976; Mabberly, 1997). Various cultivars of the three main species, *Buxus sempervirens* L., *B. microphylla* Sieb. & Zucc., and *B. sinica* (Rehd. & Wils.) M. Cheng var. *insularis* (Nakai) M.Cheng. (formerly known as *B. microphylla* var. *koreana*) are grown as ornamentals in the United States (Bir *et al.*, 1997). These plants may be trained to grow as artificially dwarfed plants.

## B. Assessment of the Weed Potential of *Buxus sinica*

If the species considered for import poses a risk as a weed pest, then a \_pest-initiated\_ risk assessment is conducted. The results of the screening for weed potential for *B. sinica* do not prompt a pest-initiated risk assessment because the plants already present and imported into the United States are not reported as weeds (Table 1).

Table 1. Weed Potential of <i>Buxus sinica</i>
Commodity: <i>Buxus sinica</i> (Buxaceae)
Phase 1: The genus <i>Buxus</i> has approximately 30 species of cultivated ornamental evergreen shrubs and small trees that are native to Western Europe, the Mediterranean, temperate East Asia, the West Indies, and Central America (Bailey <i>et al.</i> , 1976). The common box, <i>Buxus sempervirens</i> L., is widely cultivated in the United States (NRCS, 2003).
Phase 2: Is the genus <i>Buxus</i> listed in:  <div style="margin-left: 40px;"><u>NO</u> Geographical Atlas of World Weeds (Holm <i>et al.</i>, 1979) <u>NO</u> World's Worst Weeds (Holm <i>et al.</i>, 1977) or World Weeds: Natural Histories and Distribution (Holm <i>et al.</i>, 1997) <u>NO</u> Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982) <u>NO</u> Economically Important Foreign Weeds (Reed, 1977) <u>NO</u> Weed Science Society of America list (WSSA, 1989) <u>NO</u> Is there any literature reference indicating weed potential, <i>e.g.</i> AGRICOLA, CAB Biological Abstracts, AGRIS; search on "<i>Buxus</i>" combined with "weed").</div>
Phase 3: Species of <i>Buxus</i> commonly occur as introduced ornamentals in the United States (NRCS, 2003). To date, <i>B. sinica</i> is not established as a weed from bare-root importations. Continued or increased introductions of <i>B. sinica</i> are highly unlikely to pose a threat as a weed to US agriculture or ecosystems.

## C. Prior Risk Assessments, Current Status and Pest Interceptions

Currently, artificially dwarfed plants of *Buxus* species may be imported as bare-root plants (7 CFR ' 319.37). The risk assessment for *B. sinica* in growing media was completed in September 1996, and a Proposed Rule was promulgated (65 Fed. Reg. 56803-56806 on September 20, 2000). In addition, endangered species concerns necessitated consultations with the U.S. Fish and Wildlife Service. Additional mitigation measures applicable to artificially dwarfed plants were promulgated in a Final Rule (67 Fed. Reg. 53727-53731 on April 19, 2002) developed in response to interceptions of cerambycid beetles. All mitigation measures in 67 Fed. Reg. 53727-53731 (2002) apply to *B. sinica* plants that are over two years old. Interceptions of pests on bare-root *Buxus* are summarized in Table 2.

Table 2. Interceptions on species of <i>Buxus</i> imported into the United States from China between 1985 and 2003 (PIN 309, 2002).		
Pest	Year <sup>1</sup>	Interception Location
<i>Aleurotuberculatus</i> sp.	1992	general cargo
Diaspididae sp.	1988	permit cargo
<i>Eurytoma</i> sp.	1994	mail
Gracillariidae sp.	1990	passenger baggage
<i>Microsphaeropsis</i> sp.	1996	permit cargo
<i>Parlagena buxi</i>	1989, 1992, 1993, 1996	permit cargo
<i>Parlatoria</i> sp.	1991	permit cargo
<i>Phoma</i> sp.	1993	permit cargo
<i>Phomopsis</i> sp.	1996	permit cargo
<i>Puccinia buxi</i>	1987	passenger baggage
<i>Succinea horticola</i>	1996	permit cargo
Sminthuridae sp.	1991	general cargo

<sup>1</sup>There was one interception of each pest per year except for three interceptions of *Parlagena buxi* in 1989.

#### D. Pest Categorization

The pests associated with *B. sinica* are listed in Table 3. This list identifies: (1) the presence or absence of these pests in the United States, (2) the generally affected plant part or parts, (3) any additionally important hosts, (4) the quarantine status of the pest with respect to the United States, (5) whether the pest is likely to follow the pathway to enter the United States, and (6) pertinent citations for either the distribution or the biology of the pest. Because of specific characteristics of a given pest's biology and distribution, many organisms are eliminated from further consideration as sources of phytosanitary risk on *B. sinica* from China because they do not satisfy the FAO definition of a quarantine pest (FAO, 2002).

Only those quarantine pests that are likely to follow the pathway are further analyzed. A quarantine pest is, "A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled" (FAO, 2002). Pests not of potential economic importance, lacking the distribution requirements, or not under official control cannot be analyzed beyond listing in Table 3 because they do not meet internationally agreed criteria (FAO, 2001). For this same reason, organisms that are not agents injurious to plants (FAO, 2002) cannot be analyzed for phytosanitary concern.

Some of the quarantine pests listed in Table 3 may be potentially detrimental to the agricultural systems of the United States. There are a variety of reasons for not subjecting them to further analysis. Examples include, but are not limited to the following: non-fertile life stages can be transported in a shipment but are unable to establish viable populations upon entry into the United States, pests can become associated with the commodity because of packing or handling procedures (biological contaminants), or the pests may be associated with the commodity but will not remain with it during transport or processing. Insects with inherent mobility (wings, legs, etc.) and/or the instinct to avoid

light or human activity will not remain with the commodity. In contrast, quarantine pests that are unable to leave the commodity may have immobile or cryptic life stages and can follow the pathway.

Table 3. Pests Associated with <i>Buxus sinica</i> in China.						
Pest	Geographic Distribution <sup>1</sup>	Additional Host Genera <sup>2</sup>	Plant Part Affected <sup>3</sup>	Quarantine Pest	Follow Pathway	References
<b>ACARI</b>						
<b>Tenuipalpidae</b>						
<i>Brevipalpus obovatus</i> Donnadieu	CN, US	Polyphagous	Leaf	No	Yes	China, 1994; Jeppson <i>et al.</i> , 1975
<b>ARTHROPODA</b>						
<b>COLEOPTERA</b>						
<b>Curculionidae</b>						
<i>Sympiezomias velatus</i> Chevrolat <sup>4</sup>	CN	Polyphagous	Whole plant	Yes	Yes	China, 1995
<b>Scarabaeidae</b>						
<i>Adoretus sinicus</i> Burmeister <sup>4</sup>	CN, US (HI)	Polyphagous	Leaf, Root	Yes	No <sup>4</sup>	7 CFR ' 318.13; China, 1995; INKTO #89
<i>Amphimallon solstitialis</i> (L.) <sup>4</sup>	CN	Polyphagous	Leaf, Root	Yes	No <sup>4</sup>	Browne, 1968; China, 1995; CIE, 1979; INKTO #99
<i>Anomala corpulenta</i> Motschulsky <sup>4</sup>	CN	Polyphagous	Leaf, Root	Yes	No <sup>4</sup>	China, 1994, 1995
<i>Anomala cupripes</i> Hope	CN	Polyphagous	Leaf, Root	Yes	Yes	China, 1994, 1995; Gordon, 1994
<i>Phyllophaga</i> sp. <sup>6</sup>	CN, US <sup>6</sup>	Polyphagous	Leaf, Root	Yes	Yes	China, 1995; PIN 309, 2003
<i>Phyllophaga titanis</i> Reitter <sup>4</sup>	CN	Polyphagous	Leaf, Root	Yes	No <sup>4</sup>	China, 1994, 1995; Gordon, 1994
<b>COLLEMBOLA</b>						
<b>Sminthuridae</b>						
Sminthuridae sp. <sup>6</sup>	CN, US <sup>6</sup>	Various	Leaf, Soil	Yes	Yes	China, 1995; PIN 309, 2003
<b>HOMOPTERA</b>						
<b>Aleyrodidae</b>						
<i>Aleurotuberculatus hikosanensis</i> Takahashi	CN	Polyphagous	Fruit, Leaf	Yes	Yes	China, 1995; Mound and Halsey, 1978
<i>Aleurotuberculatus</i> sp. <sup>6</sup>	CN, US <sup>6</sup>	Various	Fruit, Leaf	Yes	Yes	China, 1995; PIN 309, 2003
<b>Aphididae</b>						
<i>Aphis fabae</i> (Scopoli)	CN, US	Polyphagous	Leaf, Stem	No	Yes	CPC, 2002; Stoetzel, 1994

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Pest	Geographic Distribution <sup>1</sup>	Additional Host Genera <sup>2</sup>	Plant Part Affected <sup>3</sup>	Quarantine Pest	Follow Pathway	References
<i>Aphis gossypii</i> Glover <sup>4</sup>	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1995; CIE, 1968
<i>Aphis rumicis</i> L.	CN, US	Polyphagous	Leaf, Stem	No	Yes	Smith and Parron, 1978; Wilson and Vickery, 1981; Zhang and Zhong, 1983
<i>Myzus persicae</i> (Sulzer)	CN, US	Polyphagous	Leaf, Stem	No	Yes	Blackman and Eastop, 1994; Zhang and Zhong, 1983
<b>Coccidae</b>						
<i>Ceroplastes japonicus</i> Green	CN	Polyphagous	Fruit, Leaf, Stem	Yes	Yes	China, 1994, 1995; Gimpel <i>et al.</i> , 1974; Kozar <i>et al.</i> , 1984
<i>Ceroplastes pseudoceriferus</i> Green	CN	Polypghagous	Fruit, Leaf, Stem	Yes	Yes	China, 1994, 1995; Park <i>et al.</i> , 1990
Coccidae sp. <sup>6</sup>	CN, US <sup>6</sup>	Various	Fruit, Leaf, Stem	Yes	Yes	China, 1994, 1995
<b>Diaspididae</b>						
<i>Aonidiella aurantii</i> (Maskell)	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	China, 1994; Dekle, 1965; Li and Liao, 1990; Nakahara, 1982
<i>Aspidiotus destructor</i> Signoret	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	CIE, 1966a; Dekle, 1965; Nakahara, 1982
<i>Aspidiotus nerii</i> Bouché	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	China, 1994; Dekle, 1965; Nakahara, 1982
<i>Chrysomphalus aonidum</i> L.	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	CIE, 1988a; Dekle, 1965; Nakahara, 1982
<i>Chrysomphalus dictyospermi</i> (Morgan)	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	CIE, 1969; Dekle, 1965; Garonna and Viggiani, 1989; Johnson and Lyon, 1991; Nakahara, 1982
Diaspididae sp. <sup>6</sup>	CN, US <sup>6</sup>	Various	Fruit, Leaf, Stem	Yes	Yes	China, 1995; PIN 309, 2003
<i>Lepidosaphes laterochitinsa</i> Green	CN	Polyphagous	Leaf, Stem	Yes	No <sup>4</sup>	China, 1995; ScaleNet, 2003
<i>Parlagona buxi</i> (Takahashi)	CN	Polyphagous	Fruit, Leaf, Stem	Yes	Yes	China, 1994, 1995; PIN 309, 2003
<i>Parlatoria pergandii</i> Comstock <sup>4</sup>	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	China, 1994; Dekle, 1965; Nakahara, 1982; Shen and Liu, 1990
<i>Parlatoria proteus</i> (Curtis)	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	Dekle, 1965; Nakahara, 1982
<i>Parlatoria</i> sp. <sup>6</sup>	CN, US <sup>6</sup>	Various	Fruit, Leaf, Stem	Yes	Yes	China, 1995; PIN 309, 2003

Table 3. Pests Associated with *Buxus sinica* in China.

Pest	Geographic Distribution <sup>1</sup>	Additional Host Genera <sup>2</sup>	Plant Part Affected <sup>3</sup>	Quarantine Pest	Follow Pathway	References
<i>Parlatoria ziziphi</i> (Lucas) <sup>5</sup>	CN, US (FL, HI) <sup>5</sup>	Polyphagous	Fruit, Leaf, Stem	No <sup>5</sup>	Yes	China, 1994; CIE, 1964; Dekle, 1965; PNKTO #44
<i>Pinnaspis buxi</i> Bouché	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	Nakahara, 1982; Song <i>et al.</i> , 1989
<i>Pinnaspis strachani</i> (Cooley)	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	Dekle, 1965; Nakahara, 1982
<i>Pseudaonidia clavigera</i> (Cockerell)	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	Dekle, 1965; Nakahara, 1982
<i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti) <sup>4</sup>	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	China, 1995; Dekle, 1965; Nakahara, 1982
<i>Unaspis yanonensis</i> (Kuwana)	CN	Polyphagous	Fruit, Leaf, Stem	Yes	Yes	China, 1994, 1995; CIE, 1988b; PNKTO #45; Reu <i>et al.</i> , 1990; Tanaka, 1981; Wang, 1981
<b>Fulgoridae</b>						
<i>Lycorma delicatula</i> White	CN	Polyphagous	Leaf, Stem	Yes	Yes	China, 1994, 1995; Mahmood, 1976; Metcalf, 1947
<b>Margarodidae</b>						
<i>Drosicha corpulenta</i> (Kuwana) <sup>4</sup>	CN	Polyphagous	Root, Stem	Yes	No <sup>4</sup>	China, 1994, 1995; Shiraki, 1952
<i>Icerya aegyptica</i> (Douglas) <sup>4</sup>	CN	Polyphagous	Leaf, Stem	Yes	No <sup>4</sup>	China, 1995; CIE, 1966b; INKTO #119; Williams, 1985
<i>Icerya purchasi</i> Maskell	CN, US	Polyphagous	Leaf, Stem	No	Yes	China, 1994; CIE, 1971; Myer, 1978; Salama <i>et al.</i> , 1985
<b>Ricaniidae</b>						
<i>Ricania sublimbata</i> Jacobi	CN	Polyphagous	Leaf, Stem	Yes	Yes	Chen and Gu, 1998; China, 1994; Xu and Zhong, 1988
<b>HYMENOPTERA</b>						
<b>Eurytomidae</b>						
<i>Eurytoma</i> sp. <sup>6</sup>	CN, US <sup>6</sup>	Various	Seed	Yes	No	PIN 309, 2003
<b>LEPIDOPTERA</b>						
<b>Cossidae</b>						
<i>Zeuzera coffeae</i> Nietner <sup>4</sup>	CN	Various	Leaf	Yes	Yes	China, 1994, 1995; CIE, 1973; Tang <i>et al.</i> , 1990
<b>Geometridae</b>						
<i>Ascotis selenaria</i> Denis & Schifferrmuller	CN	Polyphagous	Leaf	Yes	Yes	China, 1994, 1995

Table 3. Pests Associated with *Buxus sinica* in China.

Pest	Geographic Distribution <sup>1</sup>	Additional Host Genera <sup>2</sup>	Plant Part Affected <sup>3</sup>	Quarantine Pest	Follow Pathway	References
<i>Calospilos suspecta</i> (Warren)	CN	host specific to <i>B. magistophylla</i>	Leaf	Yes	No	China, 1995; Shen and Yang, 1998; Zhang, 1994; Zheng and Li, 1987
<b>Gracillariidae</b>						
Gracillariidae sp. <sup>6</sup>	CN, US <sup>6</sup>	Various	Leaf	Yes	Yes	PIN 309, 2003
<b>Limacodidae</b>						
<i>Thosea sinensis</i> (Walker)	CN	Polyphagous	Leaf	Yes	Yes	Bourke <i>et al.</i> , 1973; China, 1994, 1995; Hu and Wang, 1969
<b>Noctuidae</b>						
<i>Agrotis segetum</i> (Denis & Schifferrmuller) <sup>4</sup>	CN	Polyphagous	Leaf, Root, Stem	Yes	No <sup>4</sup>	Carter, 1984; China, 1995; INKTO #25
<i>Chrysodeixis chalcites</i> (Esper)	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No <sup>4</sup>	China, 1995; CIE, 1977; Goodey, 1991; Taylor, 1980
<i>Helicoverpa armigera</i> (Hübner) <sup>4</sup>	CN	Polyphagous	Inflor., Fruit, Leaf, Stem	Yes	No <sup>4</sup>	Avidov and Harpaz, 1969; China, 1995; CIE, 1993
<i>Helicoverpa assulta</i> (Guenée) <sup>4</sup>	CN	Polyphagous	Inflor., Fruit, Leaf, Stem	Yes	No <sup>4</sup>	China, 1995; CIE, 1994
<i>Mamestra brassicae</i> (L.)	CN	Polyphagous	Fruit, Inflor., Leaf, Stem	Yes	No <sup>4</sup>	China, 1995; INKTO #61
<i>Spodoptera litura</i> (F.)	CN	Polyphagous	Leaf, Root, Stem	Yes	No <sup>4</sup>	China, 1995; INKTO #12
<b>Pieridae</b>						
<i>Aporia crataegi</i> L.	CN	Polyphagous	Leaf	Yes	No <sup>4</sup>	Anon., 1972; China, 1995; INKTO #149
<b>Psychidae</b>						
<i>Clania minuscula</i> Butler <sup>4</sup>	CN	Polyphagous	Leaf	Yes	Yes	China, 1994, 1995; Kozhanchikov, 1956; Shiraki, 1952
<i>Cryptothelea variegata</i> Snellen	CN	Polyphagous	Leaf	Yes	Yes	Browne, 1968; China, 1994; 1995; Kozhanchikov, 1956
<b>Pyralidae</b>						
<i>Conogethes punctiferalis</i> (Guenée)	CN	Polyphagous	Fruit, Leaf, Stem	Yes	No <sup>4</sup>	China, 1995; INKTO #19
<i>Hymenia perspectalis</i> (Walker)	CN, US	Polyphagous	Fruit, Leaf, Stem	No	Yes	China, 1995; Solis, 2003; Tang <i>et al.</i> , 1990
<b>Zygaenidae</b>						

Table 3. Pests Associated with *Buxus sinica* in China.

Pest	Geographic Distribution <sup>1</sup>	Additional Host Genera <sup>2</sup>	Plant Part Affected <sup>3</sup>	Quarantine Pest	Follow Pathway	References
<i>Pryeria sinica</i> Moore	CN, US (MD, VA)	<i>Euonymus</i>	Leaf	Yes	Yes	Anon., 1986; Brown, 2003; China, 1994, 1995
<b>ORTHOPTERA</b>						
<b>Acrididae</b>						
<i>Atractomorpha sinensis</i> Bol. <sup>4,5</sup>	CN, US (HI)	Polyphagous	Leaf, Soil	No <sup>5</sup>	No <sup>4</sup>	China, 1994, 1995
<b>Gryllotalpidae</b>						
<i>Gryllotalpa orientalis</i> Burmeister (= <i>G. africana</i> Palisot de Beauvois) <sup>4,5</sup>	CN, US (HI)	Polyphagous	Root	No <sup>5</sup>	No <sup>4</sup>	China, 1995; Hua, 2000; INKTO #197
<b>Trydactylidae</b>						
<i>Tridactylus japonicus</i> de Hoan	CN	Polyphagous	Root	Yes	Yes	China, 1994, 1995; Shiraki, 1952
<b>FUNGI</b>						
<i>Cercospora destructiva</i> (Ravenel) Ellis & Everh. (Fungi Imperfecti, Hyphomycetes)	CN, US	<i>Euonymus</i>	Leaf	No	Yes	China, 1992; Farr <i>et al.</i> , 1989
<i>Dennisiella babingtonii</i> (Berk.) Batista & Cif. Anamorph: <i>Microxiphium fagi</i> (Pers.) S. J. Hughes (Ascomycetes, Dothideales)	CN, US	<i>Ilicium</i>	Leaf	No	Yes	China, 1992; Farr <i>et al.</i> , 1989
<i>Fusarium oxysporum</i> Schlechtend.:Fr. (Fungi Imperfecti, Hyphomycetes)	CN, US	Various genera	Root, Branches	No	Yes	China, 1992; Farr <i>et al.</i> , 1989
<i>Glomerella cingulata</i> (Stoneman) Spaulding & Schrenk Anamorph: <i>Colletotrichum gloeosporoides</i> (Penz.) Penz., & Sacc. in Penz. (Ascomycetes, Phyllachorales)	CN, US	Various genera	Leaf	No	Yes	Farr <i>et al.</i> , 1989; Tai, 1979
<i>Guignardia miribelii</i> van der Aa (Anamorph: <i>Sarcophoma miribelii</i> (Fr.) Hohn.)[Syn.: <i>Macrophoma miribelii</i> (Fr.) Berl. & Vogl. (Ascomycetes, Dothideales)]	CN	No additional hosts	Leaf, Stem	Yes	Yes	China, 1995; Sutton, 1980
<i>Macrophoma ehretia</i> Cook & Mass. (Fungi Imperfecti, Coelomycetes)	CN	<i>Ehretia</i>	Leaf, Stem	Yes	Yes	China, 1995; Tai, 1979

Table 3. Pests Associated with *Buxus sinica* in China.

Pest	Geographic Distribution <sup>1</sup>	Additional Host Genera <sup>2</sup>	Plant Part Affected <sup>3</sup>	Quarantine Pest	Follow Pathway	References
<i>Meliola buxicola</i> Doidge (Ascomycetes, Meliolales)	CN	No additional hosts	Leaf	Yes	Yes	Tai, 1979
<i>Microsphaera euonymi-japonici</i> Vien.-Bourg. Anamorph: <i>Oidium euonymi-japonici</i> (Arcang.) Sacc. in E. S. Salmon (Ascomycetes, Erysiphales)	CN, US	<i>Euonymous</i>	Leaf	No	Yes	China, 1992; Farr <i>et al.</i> , 1989
<i>Microsphaeropsis</i> sp. <sup>6</sup> (Fungi Imperfecti, Coelomycetes)	CN, US <sup>6</sup>	Various	Leaf	Yes	Yes	PIN 309, 2003
<i>Pestalotia breviseta</i> Sacc. (Fungi Imperfecti, Coelomycetes)	CN, US	<i>Acacia</i> , <i>Quercus</i>	Leaf	No	Yes	China, 1992; Farr <i>et al.</i> , 1989
<i>Phoma</i> sp. (Fungi Imperfecti, Coelomycetes) <sup>6</sup>	CN, US <sup>6</sup>	Various	Whole plant, Soil	Yes	Yes	China, 1992; PIN 309, 2003
<i>Phomopsis</i> sp. (Fungi Imperfecti, Coelomycetes) <sup>6</sup>	CN, US <sup>6</sup>	Various	Leaf, Stem	Yes	Yes	PIN 309, 2003
<i>Phyllosticta nandinae</i> Tassi (Fungi Imperfecti, Coelomycetes)	CN, US	<i>Nandina</i>	Leaf	No	Yes	China, 1992; Farr <i>et al.</i> , 1989
<i>Puccinia buxi</i> DC Syn.: <i>Dasyscypha buxi</i> Arth. (Basidiomycetes, Uredinales)	CN	No additional hosts	Leaf	Yes	Yes	China, 1992; Farr <i>et al.</i> , 1989; PIN 309, 2003; Smith <i>et al.</i> , 1988
<i>Thanatephorus cucumeris</i> (A.B. Frank) Donk Anamorph: <i>Rhizoctonia solani</i> Kühn (Basidiomycetes, Tulasnellales)	CN, US	Various genera	Root, Stem	No	Yes	China, 1992; Teng, 1996
<b>NEMATODA</b>						
<b>Heteroderidae</b>						
<i>Meloidogyne incognita</i> (Chitwood)	CN, US	Various genera	Root, Soil	No	Yes	Anon., 1984; China, 1992, 1995
<b>Hoplolaimidae</b>						
<i>Helicotylenchus dihystra</i> (Cobb) Sher	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; China 1992, 1995
<b>Nacobbidae</b>						
<i>Nacobbus aberrans</i> (Thorne) Thorne & Allen (Syn.: <i>Pratylenchus aberrans</i> (Thorne) Filipjev)	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; China, 1992
<b>Pratylenchidae</b>						

Table 3. Pests Associated with *Buxus sinica* in China.

Pest	Geographic Distribution <sup>1</sup>	Additional Host Genera <sup>2</sup>	Plant Part Affected <sup>3</sup>	Quarantine Pest	Follow Pathway	References
<i>Pratylenchus penetrans</i> (Cobb) Filipjev & Stekhoven	CN, US	Polyphagous	Root, Soil	No	Yes	Anon., 1984; China, 1995
<b>MOLLUSCA</b>						
<b>Bradybaenidae</b>						
<i>Acusta ravida</i> (Benson)	CN	Polyphagous	Whole plant, Soil	Yes	Yes	China, 1995; Likhachev and Ramme-Meier, 1962
<i>Bradybaena similis</i> (Ferussac)	CN, US	Polyphagous	Whole plant, Soil	No	Yes	Chang and Chen, 1989; China, 1994; Dundee, 1970; Yen, 1943
<b>Succineidae</b>						
<i>Succinea horticola</i> Reinhart	CN	Polyphagous	Whole plant, Soil	Yes	Yes	PIN 309, 2003

<sup>1</sup>Geographic Distribution: CN -China, US -United States, FL -Florida, HI -Hawaii, TX -Texas. Individual states are listed only if the pest is reported in less than five states within the United States. The organism with limited US distribution that is likely to follow the pathway is *Pryeria sinica*. For the purpose of this document, it is analyzed as a quarantine pest because its recent

discovery in Virginia and its ecological limits may not yet have been reached, so an official control program may be implemented in the future. Analysis in this document shall not be construed as any type of indicator on future agency policy for these pests.

<sup>2</sup>APolyphagous@means the species feeds and reproduces on multiple hosts in multiple plant families. AVarious@means different species use a variety of hosts. When species of *Buxus* are the only hosts reported in the available literature, then ANo additional hosts@is noted in the table.

<sup>3</sup>Plant Part Affected: Inflor. = inflorescence.

<sup>4</sup>The following insect pests are generalist feeders that were not listed as present on *Buxus* in Chinese penjing gardens (China, 1995): *Adoretus sinicus*, *Agrotis segetum*, *Amphimallon solstitialis*, *Anomala corpulenta*, *Aporia crataegi*, *Atractomorpha sinensis*, *Chrysodeixis chalcites*, *Conogethes punctiferalis*, *Drosicha corpulenta*, *Gryllotalpa orientalis* (*G. africana* or *G. africans*), *Helicoverpa armigera*, *H. assulta*, *Icerya aegyptica*, *Lepidosaphes laterochitina*, *Mamestra brassicae*, *Phyllophaga titanis*, *Spodoptera litura* (China, 1995). Published biological evidence validates the information supplied by the Chinese government that *Buxus* is not a host of these pests. In 1996, some of these pests were assessed as following the pathway due to their generalist habits and the information available at the time, but current information shows that these pests are not likely to follow the pathway of the importation.

<sup>5</sup>Although this pest has a limited distribution in the United States, it is not under Official control and does not meet the definition of a quarantine pest (FAO, 2002). However, analysis in this document shall not be construed as any type of indicator on future agency policy for these pests.

<sup>6</sup>These organisms have been intercepted by PPQ during inspections of these plants. Lack of species identification may indicate the limits of the current taxonomic knowledge or the life stage or the quality of the specimen submitted for identification. However, the particular taxon, at the level identified, is represented in the United States, e.g. Diaspididae sp.

The biological hazard of organisms not identified to the species level is not directly assessed.

Stakeholder comments to this analysis suggested that even if USDA did not have information about specific quarantine species, it should assume that they exist. That approach (specifically, assuming there are hazards without evidence to identify these hazards) is not consistent with international guidelines or

agreements. It is reasonable, however, to assume that the biologies of congeneric organisms are similar and can be related to organisms that are analyzed and that specific, applicable mitigations that target biologically similar groups (similar in a phytosanitary-relevant sense: meaning similar treatments/controls apply) will apply. In this document the biological information available for *Anomala cupripes* (Coleoptera: Scarabaeidae) is used to analyze *Phyllophaga* sp. (Coleoptera: Scarabaeidae); literature available on *Aleurotuberculatus hikosanensis* (Homoptera: Aleyrodidae) is used to analyze *Aleurotuberculatus* congenics; literature for the two species of *Ceroplastes* (Homoptera: Coccidae) is used to analyze other Coccidae; literature for *Parlagena buxi* (Homoptera: Diaspididae) is used to analyzed *Parlatoria* congenics and other Diaspididae; and *Macrophoma ehretia* literature reasonably encompasses the Coelomycete fungal genera *Microsphaeropsis*, *Phoma* and *Phomopsis*.

Lack of species identification may indicate the limits of the current taxonomic knowledge or the life stage or the quality of the specimen submitted for identification. In this risk assessment, this applies to the interceptions of Sminthuridae and Gracillaridae. When only genus-level identification is available and other evidence indicates that pest species in that genus occur in the immediate vicinity and in association with the commodity, then it is assumed that such pest species may be present. There was no evidence of this type for these species. Development of detailed assessments for pests known to inhabit a variety of ecological niches, such as the surfaces or interiors of stems or roots, allow effective mitigation measures to eliminate the known organisms as well as similar, but incompletely identified organisms, that inhabit the same niche.

Some of the pests in Table 2 identified only to the order, family or generic level are associated with *Buxus sinica* only through interceptions of these pests by PPQ Officers from cargo, passenger baggage or mail (and the true origin of these plants was not known). Quarantine action was taken on the commodity because there are quarantine significant pests in those taxa, *e.g.*, Sminthuridae. Often the pest could not be completely identified because the intercepted life stage lacks structures that allow identification to species. However, even if species identification was possible, these pests may or may not belong to quarantine pest species. The intercepted pests identified only to higher taxa may actually belong to a non-quarantine species already addressed in the document under a specific epithet, *e.g.*, the Diaspididae includes non-quarantine pests like *Aonidiella aurantii*. Nevertheless, quarantine action is required when incompletely identified organisms are intercepted because of the presence of quarantine organisms in those taxa. If pests identified only to higher taxa are intercepted in the future, then reevaluations of their risk may occur. In this risk assessment, this applies to the following taxa: *Aleurotuberculatus*, Coccidae, Diaspididae, Gracillaridae, *Microsphaeropsis*, *Parlatoria*, *Phoma*, *Phomopsis*, *Phyllophaga*, and Sminthuridae.

The quarantine pests that are likely to follow the pathway of importation on species of *B. sinica* from China and that are further analyzed in this risk assessment are summarized in Table 4.

Table 4. Quarantine Pests Likely to Follow Pathway on <i>Buxus sinica</i> from China	
<b>ARTHROPODA</b>	<b>MOLLUSCA</b>

<p><b>Coleoptera</b>  <i>Anomala cupripes</i> Hope (Scarabaeidae)  <i>Sympiezomias velatus</i> Chevrollet (Curculionidae)</p> <p><b>Homoptera</b>  <i>Aleurotuberculatus hikosanensis</i> Takahashi (Aleyrodidae)  <i>Ceroplastes japonicus</i> Green (Coccidae)  <i>Ceroplastes pseudoceriferus</i> Green (Coccidae)  <i>Lycorma delicatula</i> White (Fulgoridae)  <i>Parlagena buxi</i> (Takahashi) (Diaspididae)  <i>Ricania sublimbata</i> Jacobi (Ricanidae)  <i>Unaspis yanonensis</i> (Kuwana) (Diaspididae)</p> <p><b>Lepidoptera</b>  <i>Ascotis selenaria</i> Denis &amp; Schiffermuller (Geometridae)  <i>Clania minuscula</i> Butler (Psychidae)  <i>Cryptothelea variegata</i> Snellen (Psychidae)  <i>Pryeria sinica</i> Moore (Zygaenidae)  <i>Thosea sinensis</i> (Walker) (Limaecodidae)  <i>Zeuzera coffeae</i> Nietner (Cossidae)</p> <p><b>Orthoptera</b>  <i>Tridactylus japonicus</i> de Hoan (Tridactylidae)</p>	<p><i>Acusta ravidia</i> (Benson) (Bradybaenidae)  <i>Succinea horticola</i> Reinhart (Succineidae)</p> <p><b>FUNGI</b>  <i>Guignardia miribelii</i> van der Aa (Loculoascomycetes, Dothideales)  <i>Macrophoma ehretia</i> Cook &amp; Mass. (Fungi Imperfecti, Coelomycetes)  <i>Meliola buxicola</i> Doidge (Pyrenomycetes, Meliolales)  <i>Puccinia buxi</i> DC (Basidiomycetes, Uredinales)</p>
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## E. Analysis of Quarantine Pests

The undesirable consequences that may occur from the introduction of quarantine pests are assessed within this section. For each quarantine pest, the Pest Risk Potential is calculated by summing the values for the Consequences of Introduction and the Likelihood of Introduction.

The major sources of uncertainty present in this risk assessment are similar to those in other risk assessments. They include the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990), and the evaluation of risk by comparisons to lists of factors within the guidelines (Kaplan, 1992). To address this last source of uncertainty, the lists of factors were interpreted as illustrative and not exhaustive. This implies that additional biological information, even if not explicitly part of the criteria, can be used when it informs a rating. Sources of uncertainty in this analysis stem from the quality of the available biological information (Gallegos and Bonano, 1993), and the inherent, natural biological variation within a population of organisms (Morgan and Henrion, 1990).

## Consequences of Introduction

This portion of the assessment considers negative outcomes that may occur when the quarantine pests identified as following the pathway of *B. sinica* penjing plants from China are introduced into the United States. The potential consequences are evaluated using five Risk Elements (APHIS, 2000): Climate-

Host Interaction, Host Range, Dispersal Potential, Economic Impact, and Environmental Impact. These risk elements reflect the biology, host range and climatic and geographic distribution of each pest, and are supported by biological information on each of the analyzed pests. For each risk element, pests are assigned a rating of Low (1 point), Medium (2 points), or High (3 points) (APHIS, 2000). The summation of the points for each risk rating is the cumulative value for the Consequences of Introduction (Table 5). A cumulative value of 5 to 8 points is considered Low risk for the Consequences of Introduction, 9 to 12 points is Medium, and 13 to 15 points is considered High (APHIS, 2000).

#### Risk Element 1: Climate/Host Interaction

This risk element considers ecological zonation and the interactions of quarantine pests with their biotic and abiotic environments. When introduced into new areas, pests are expected to behave as they do in their native areas if the potential host plants and suitable climate are present. Broad availability of suitable climates and a wide distribution of suitable hosts are assumed to increase the impact of a pest introduction. The ratings for this risk element are based on the relative number of United States Plant Hardiness Zones (ARS, 1960) with potential host plants and suitable climate.

In general, the varied climate in China corresponds to many of the climatological regions in the United States because they are at similar latitudes and range from coastal to mountainous regions (Hou, 1983).

Penjing plants may be placed outdoors during favorable weather, but generally are expected to be grown indoors and/or in temperature controlled production facilities (Hartmann and Kester, 1959). It appears that at least four US Plant Hardiness zones are suitable for population establishment by all of the pests. The risk rating of High (3) is given for each of these species for the Climate-Host Interaction Risk Element.

#### Risk Element 2: Host Range

The risk posed by a plant pest depends on both its ability to establish a viable, reproductive population and its potential to damage plants. This risk element assumes that the consequences of pest introduction are positively correlated with the pest's host range. Aggressiveness, virulence and pathogenicity also may be factors. The consequences are related to host range are rated in accordance with the ability of the pest to attack a single species or multiple species within a single genus, a single plant family, or multiple families. The large number of hosts, in multiple plant families, attacked by these pests warrants a risk rating for Host Range of High (3) for all of the pests unless otherwise noted. The discussion on the insect pests is grouped by Order.

Coleoptera: The scarab beetle *Anomala cupripes* feeds on plants in the following genera: *Buxus*, *Camellia*, *Delonix*, *Dimocarpus*, *Ficus*, *Hevea*, *Litchi*, and *Mangifera* (China, 1995; CPC, 2002).

The weevil *Sympiezomias velatus* feeds on at least the following plants: *Beta*, *Buxus*, *Castanea*, *Glycine*, *Morus*, *Populus*, and *Sophora* (China, 1995).

Homoptera: The hosts of *Aleurocanthus hikosanensis* include: *Buxus*, *Cinnamomum*, *Eurya*, *Ilex*, *Pittosporum* (China, 1995), and *Enkianthus* (PIN 309, 2003). *Ceroplastes japonicus* and *C. pseudoceriferus* feed on the following plants: *Buxus*, *Camellia*, *Cedrus*, *Chaenomeles*, *Citrus*, *Cycas*, *Cunninghamia*, *Diospyros*, *Gardenia*, *Ilex*, *Litchi*, *Magnolia*, *Malus*, *Mangifera*, *Michelia*, *Morus*, *Nandina*, *Pinus*, *Podocarpus*, *Prunus*, *Punica*, *Pyrus*, *Rosa*, *Rosaceae*, *Salix*, and *Ulmus* (China, 1995; CPC, 2002). The hosts of *Lycorma deliculata* include: *Buxus*, *Catalpa*, *Glycine*, *Ligustrum*, *Malus*, *Melia*, *Platanus*, *Populus*, *Prunus*, *Quercus*, *Toona*, and *Ulmus* (China, 1995). The hosts of *Parlagena buxi* include *Buxus*, *Euonymus*, *Ulmus*, and *Ziziphus* (China, 1995; CPC, 2002; Hua, 2000). The hosts of *Ricania sublimbata* include *Buxus*, *Citrus*, *Ligustrum* (China, 1995), and *Eucalyptus* (Chen and Gu, 1998). *Unaspis yanonensis* is associated primarily with *Citrus*, *Damnacanthus*, *Fortunella* (PNKTO #45, 1984), *Camellia* and *Dimocarpus* (Hua, 2000). Other hosts include *Buxus*, *Osmanthus*, *Prunus*, and *Punica* (China, 1995).

Lepidoptera: The hosts of *Ascotis selenaria* include *Buxus*, *Rosa*, and *Sophora* (China, 1995), *Artemisia*, *Camellia*, *Citrus*, *Daucus*, *Fagopyrum*, *Morus* (Shiraki, 1952). The hosts of *Clania miniscula* include: *Acer*, *Bischofia*, *Buxus*, *Camellia*, *Castanea*, *Citrus*, *Cupressus*, *Fraxinus*, *Lagerstroemia*, *Magnolia*, *Malus*, *Morus*, *Pinus*, *Platanus*, *Podocarpus*, *Populus*, *Prunus*, *Punica*, *Pyrus*, *Quercus*, *Ribes*, *Rosa*, *Rubus*, *Salix*, *Sapium*, *Thea*, *Ulmus*, and *Vitis* (China, 1995; CPC, 2002). The hosts for *Cryptothelea variegata* include *Albizia*, *Buxus*, *Capsicum*, and *Myristica* along with other plants that are not grown within the United States including tea, coffee and chocolate (Zhang, 1994). Additional hosts include *Casurina*, *Cinnamomum*, *Ginkgo*, *Manihot*, *Pinus*, *Podocarpus*, *Pyracantha*, *Malus*, *Rosa* and *Ulmus* (China, 1995; CPC, 2002). The currently recognized hosts of *Pryeria sinica* are *Buxus*, *Celastrus* and *Euonymus* (Brown, 2003; China, 1995), so the host range rating is High (3). The hosts of *Zeuzera coffeae* include: *Acacia*, *Abelmoschus*, *Artocarpus*, *Buxus*, *Camellia*, *Ceiba*, *Citrus*, *Coffea*, *Gossypium*, *Malus*, *Manihot*, *Metasequoia*, *Persea*, *Pimenta*, *Platanus*, *Pterocarya*, *Punica*, *Robinia*, *Santalum*, *Sapium*, *Sophora*, *Swietenia*, *Tectona*, *Theobroma*, *Vitis* and *Zea* (China, 1995; CPC, 2002).

The hosts for *Thosea sinensis* are *Camellia sinensis* (Zhang, 1994) and *Buxus* (China, 1994), but there may be other currently recognized hosts in the plant families Palmae, Punicaceae, Rubiaceae, Rutaceae and Theaceae (CPC, 2002). The rating is Low (1) based on the confirmed host range (Zhang, 1994) as of the date of the original risk assessment.

Orthoptera: The hosts of *Tridactylus japonicus* include *Buxus*, *Camellia*, *Cedrus*, *Fragaria*, *Gossypium*, *Nicotiana*, *Oryza*, *Rosa*, *Sabina*, and *Saccharinum* (China, 1995; CPC, 2003).

Mollusca: Snails, e.g., *Acusta ravidia* and *Succinea horticola*, feed on foliage, flowers and fruit from various plant species, especially in greenhouses (Godan, 1983; Robinson, 2003), so identifying specific hosts is likely to underestimate the full range of host plants. For example, a listing of plants intercepted with *Succinea horticola* from China includes: *Buxus*, *Carmona*, *Chamaedorea*, *Dracaena*, *Pinus*, *Serissa* and *Zelkova* (PIN 309, 2003); a listing of plants intercepted with *Acusta* (*Bradybaena*)

species: *Aechmea*, *Alpinia*, *Anthurium*, *Apsidium*, *Asparagus*, *Barringtonia*, *Brassica*, *Carmona*, *Celtis*, *Crinum*, *Cymbidium*, *Durio*, *Echinodorus*, *Fagus*, *Ficus*, *Lammaphyllum*, *Ochna*, *Oncidium*, *Pachira*, *Phaius*, *Phalaenopsis*, *Podocarpus*, *Polyscias*, *Saeretia*, *Vanda*, *Vitis*, and *Zingiber* (PIN 309, 2003).

Fungi: The host range for *Guignardia miribelii* includes *Buxus* sp., *B. arborescens*, and *B. sempervirens* (ARS, 2001). The host range for *Puccinia buxi* includes *B. sempervirens* (ARS, 2001). The host range for *Meliola buxicola* includes *Buxus* sp., *B. macowanii*, and *Goupia glabra* (ARS, 2001). The current name for *Goupia glabra* is *G. paraensis*, which does not occur in the United States (NRCS, 2003), so multiple plant host families are not present, and therefore not at-risk, in the United States. A Host Range rating of Low (1) is met by these very limited host ranges. The host range for *Macrophoma ehretia* includes *Buxus* spp., *Ehretia formosana* and *E. resinosa* (Boraginaceae) (ARS, 2001), so the risk rating is Medium (2).

### Risk Element 3: Dispersal Potential

Pests may disperse after introduction into new areas. The dispersal potential indicates how rapidly and widely the pests may spread may be expressed within the importing country or region and is related to the pests reproductive potential, inherent mobility, and external dispersal facilitation modes. Factors for rating the dispersal potential include: the presence of multiple generations per year or growing season, the relative number of offspring or propagules per generation, any inherent capabilities for rapid movement, the presence of natural barriers or enemies, and dissemination enhanced by wind, water, vectors, or human assistance.

In the United States, plants within the genus *Buxus* are widely distributed in temperate and subtropical regions, and grown as ornamentals (Bailey *et al.*, 1976; Mabberly, 1997). Artificially dwarfed plants may be placed out-of-doors in many areas of the United States, or they may be grown as indoor ornamentals. Mobile pests that arrive could migrate to other *Buxus* plants or other nearby native host plants particularly if placed outdoors (Jarvis, 1992). All pests are rated High (3) for dispersal potential unless otherwise noted.

The dispersal potential for the insects is high because the adults are mobile and capable of producing many eggs per generation. *Lycorma delicatula* (Homoptera) and the Lepidoptera (*Ascotis selenaria*, *Clania miniscula*, *Cryptothelea variegata*, *Pryeria sinica*, *Thosea sinensis*, and *Zeuzera coffeae*) fly as adults (Borror *et al.*, 1989; Brown, 2003; Carter 1984).

*Tridactylus japonicus* is a soil inhabitant and adults and nymphs are highly mobile (Borror *et al.*, 1989). Similarly *Anomala cupripes* feeds on fine plant roots and decaying vegetable matter as larvae, has one generation per year, pupates in the ground (Hogue, 1993), and are strong fliers as adults (CPC, 2002). In Hong Kong nurseries, swarms of adult *A. cupripes* caused serious injury to young *Pinus* and *Eucalyptus* species (Browne, 1968). The dispersal capabilities of *Sympiezomias velatus* are not known. However, many curculionids, e.g., *Anthonomus grandis* Boheman

(<http://www.ceris.purdue.edu/napis/pests/bw/facts.txt>), are capable of widespread distribution.

*Aleurotuberculatus hikosanensis* nymphs are sessile. Alate adults are capable of local dispersion (around 200 m) and can disperse great distances with agricultural commodities in trade (CPC, 2002).

Newly emerged first-instar nymphs are the main dispersal agents in the Coccoidea (Gullan and Kosztarab, 1997). They are passively dispersed by the wind for up to several hundred meters and have adapted various morphological structures to increase wind-borne dispersal capabilities (Gullan and Kosztarab, 1997). This basic biology, exhibited by *P. buxi* and *R. sublimbata* is illustrative for the following Homoptera.

The crawlers of *Ceroplastes japonicus* and *C. pseudoceriferus* may use wind currents to aid dispersal (Greathead, 1989) and have the potential to disperse over 190 km on wind currents (Washburn and Washburn, 1984). In Korea, both species are univoltine (Jiang and Gu, 1988; Park *et al.*, 1990). The egg laying capacity for *C. japonicus* was 1,196 to 2,094 eggs per female, and 1,073 eggs per female in *C. pseudoceriferus* Korea (Park *et al.*, 1990). In Taiwan, *C. pseudoceriferus* is trivoltine and the number of eggs per female averaged 1445.2, 1103.5 and 1287.7 for these, respectively (Wen and Lee, 1986).

In Chinese penjing gardens, *Unaspis yanonensis* has two to three generations per year from overwintering adult females who lay eggs in May, the last of July, and the last of September (China, 1995). In Japan, average egg production was 177, 133, 196 for each generation, respectively (PNKTO #45, 1984) with up to three generations per year (Clausen, 1931; PNKTO #45, 1984), and females may lay up to 200 eggs (Miller, 1985). First instar nymphs settle on hosts shortly after hatching (PNKTO #45, 1984) or disperse by wind or other means (Rosen, 1990; Stehr, 1991).

Snails are spread in commerce, may lay up to 100 eggs at one time (Anon., 2003), and due to their hermaphroditism, one organism can start a population (Anon., 2003; Godan, 1983). The dispersal and establishment potential of members of this taxa are illustrated by *Acusta similis* (Ferussac), a tropical species from China, which has established in Hawaii and Louisiana (Burch, 1962). *Succinea horticola* Reinhart, the most important species of its snail family, and a very severe pest of greenhouse plants and grasses, is found mainly in China, Japan and Okinawa, and also occurs in Greece and Italy (AFPMB, 1993). Although this species is not listed as a traveling species, succineids are difficult to identify to the species level (Robinson, 1999). Currently, snail infestations are of heightened concern to APHIS-PPQ because of increase in volume of transported materials and the establishment of the Channeled apple snail, *Pomacea caniculata* (Lamarck) in California and Texas (Robinson, 1999; Smith and Fowler, 2002).

*Guignardia miribelli* and *Macrophoma ehretia* belong to genera in which the spores are forcibly discharged from fruiting structures and then dispersed by wind and rain (Agrios, 1997; Pirone, 1978).

The spores of *Meliola buxicola* also are water splashed, so dispersal to outdoor nearby plants is likely to be more limited for these fungi than for the *Puccinia buxi* which releases aerial spores (Agrios, 1997). For these reasons, the dispersal potential for the pathogens is Medium (2) except for *P. buxi* which is rated High (3).

#### Risk Element 4: Economic Impact

Introduced pests cause a variety of direct and indirect economic impacts, such as reduced yield, reduced commodity value, loss of foreign or domestic markets, and non-crop impacts. Factors considered during the ranking process included: effect on yield or commodity quality, plant mortality, ability to act as a disease vector, increased costs of production including pest control costs, lower market prices, effects on market availability, increased research or extension costs, or reduction in recreational land use or aesthetic value. All of the pests are rated High (3) for economic impact unless otherwise noted.

The hosts of *Anomala cupripes* generally grow in warmer areas of the country and have limited US agricultural production (China, 1995; CPC, 2002). *Sympiezomias velatus* feeds on economically or environmentally important species of *Glycine* and *Populus* (China, 1995). Because both of these species may cause yield loss and increase production costs they are rated Medium (2).

*Aleurotuberculatus hikosanensis*, *Lycorma deliculata*, and *Parlagena buxi*, are rated Medium (2) for economic impact because these pests generally do not kill their hosts or act as vectors of quarantine pathogens. The indirect economic effects to non-cultivated plants include reduced vigor of plants within the landscape, and reservoirs for pest spread. Extant control practices for similar pests present in the United States (Pirone, 1978) are likely to reduce the economic impacts associated with these pests. *Unaspis yanonensis* is an important citrus pest and cause economically important damage that requires chemical pesticide control (Clausen, 1931; CPC, 2002; Kosztarab, 1996; PNKTO #45, 1984). *Citrus* is also a host of *Ceroplastes japonicus*, *C. pseudoceriferous*, and *Ricania sublimbata* (China, 1995), so the economic impact of these Homoptera is rated High (3) because of the importance of the citrus industry to US agriculture.

The Lepidoptera pests are expected to be leaf feeders that either chew holes in the leaves or on leaf margins (Borror *et al.*, 1989). Species of *Ascotis* can defoliate plants (Ohtani *et al.*, 2001) and are devastating to avocados in Israel (Pena *et al.*, 2002). In contrast, twig and stem boring by *Zeuzera coffeae* is economically important in Southeast Asia on coffee and cocoa (Waterhouse, 1993). For all the Lepidoptera, the rating is High (3) for economic impact because they feed on many ornamental plants (Borror *et al.*, 1989; Brown, 2003; Ohtani *et al.*, 2001; Pena *et al.*, 2002; Waterhouse, 1993).

*Tridactylus japonicus*, attacks economically important species of *Gossypium*, *Nicotiana*, *Oryza*, *Rosa*, and *Saccharinum* (China, 1995; CPC, 2003), so it is rated High (3).

Mollusk feeding reduces the visual quality of the plant, the available photosynthetic surface area, and

some mollusks clip succulent plant parts (Godan, 1983; Ohlendorf, 1999; Lai, 1984). The introduction of *Acusta similis* (Ferrussac) into Louisiana and other states from tropical China necessitated control treatments for this occasional citrus and garden pest (Aguirre and Poss, 2000). It is anticipated that if *A. ravidia* or *Succinea horticola* are introduced into a new areas, there will be a need for similar control measures, so the rating is High (3).

Presence of the fungal leaf-spot pathogens reduce the market value of plants when observed by potential buyers (Agrios, 1997; Pirone, 1978). Most leaf-spot causing pathogens reduce visual quality, available photosynthetic area, and plant vigor (Agrios, 1997; Jarvis, 1992; Kahn and Mathur, 1999; Pirone, 1978). Also, whiteflies secrete honeydew, which encourages the growth of aesthetically undesirable sooty molds, such as *Meliola buxicola* (Agrios, 1997; CPC, 2002; Pratt, 1958). The risk rating for the Economic Impact for these pathogens is Medium (2).

#### Risk Element 5: Environmental Impact

The ratings for this risk element are based on three aspects: the potential of the pest to disrupt native ecosystems, and the habits exhibited within its current geographic range; the need for additional chemical or biological control programs due to the presence of the pest; and the potential of the pest to directly or indirectly impact species listed as Threatened or Endangered (50 CFR ' 17.11-12) by infesting or infecting a listed plant that is congenierics as its hosts. When a pest is known to infest or infect other species within the same genus, and feeding preference data does not exist with the listed plant, then the listed plant is assumed to be a potential host. For all the pests, the rating for environmental impact is Medium (2) unless otherwise noted.

The insect pests exhibit wide host ranges in China, but the most likely effect of many of these pests is to reduce vigor although young plants can be killed (Agrios, 1997; Carter, 1984; Borror *et al.*, 1989; Hill, 1987). Every pest identified in the risk assessment has members of the genus *Buxus* as hosts; the only endangered species is *Buxus vahlii* which occurs only in Puerto Rico and the Virgin Islands (USFWS, 2002). There are no other threatened, endangered, proposed or candidate species within *Buxus* (USFWS, 2002). If the entry of *B. sinica* is restricted to the continental United States, then these at-risk plant populations will have the additional protection of distance from the pests analyzed in this document. For the following pests, there are no additional hosts in the same genus as a Threatened, Endangered or Candidate species (USFWS, 2002): *Aleurotuberculatus hikosanensis*, *Ascotis selenaria*, *Pryeria sinica*, *Ricania sublimbata*, *Sympeizomias velatus*, and *Tridactylus japonicus*.

Sustained epidemics over time are often needed for leaf-spot pathogens to directly kill host plants (Agrios, 1997; Van der Plank, 1963). All the pathogens attack *Buxus* (ARS, 2001; Tai, 1979). *Macrophoma ehretia* also infects two species of *Ehretia* (ARS, 2001; Tai, 1979). Current IPM practices for *Buxus* species control the indigenous leaf spot *M. candollei* (Pirone, 1978). Control of *M. ehretia* is expected to be achieved by these methods if this pest establishes in the United States. The superficial mycelia of sooty molds, such as *M. buxicola*, are easily reduced or eliminated by washing or wiping off the mold so that chemical control measures are not necessary (Agrios, 1997).

While rust fungi are devastating to susceptible crops under intense agricultural production practices, the spread of rusts in non-agronomic situations is likely to be highly dependent on both plant density and prevailing environmental conditions (Agrios, 1997; Gilbert, 2002; Van der Plank, 1963).

Potential hosts for *Ceroplastes japonicus* and *C. pseudoceriferus* could include the Hawaiian Endangered species *Gardenia brighamii*, *G. mannii*; the Puerto Rican populations of *Ilex cookii* and *I. sintenisii* and the Hawaiian Candidate species *G. remyi* (USFWS, 2002). The larger host range for *C. japonicus* indicates that the Endangered species *Prunus geniculata* and *Ziziphus celata* in Florida, along with the Threatened species *Quercus hinckleyi* in Texas also are potential hosts for this pest. *Anomala cupripes* feeds on *Vigna*; *V. o-wahuensis* is an Endangered species in Hawaii. For these pests, the rating is High (3).

The host range of *Unaspis yanonensis* suggests that establishment in non-agronomic ecosystems may be limited if this pest is introduced into the United States (Hua, 2000; PNKTO #45, 1984). Chemical or biological control programs were successful for this pest in commercial citrus growing areas in Japan and France (PNKTO #45, 1984), but these types of programs are not expected to be used in non-agronomic areas. For these reasons, the rating is Low (1).

Hosts of *Clania miniscula* include landscape dominant species of *Acer*, *Pinus*, *Platanus*, *Ulmus* and the Rosaceae in addition to crops such as citrus and grapes (China, 1995; CPC, 2002). Hosts also are congeneric with Threatened populations of *Quercus hinckley* in Texas, Endangered *Rhododendron chapmanii* populations in Florida, Endangered *Solanum drymophilum* populations in Puerto Rico, Endangered *S. incompletum* and *S. sandwicense* populations and Candidate *S. nelsonii* populations in Hawaii (USFWS, 2002). For all these reasons, the rating is High (3) for this pest.

The host range for *Lycorma delicatula* may include the Threatened species, *Quercus hinckleyi* in Texas, and Endangered populations of *Rhododendron chapmanii* in Florida. The host range for *Cryptothelea variegata* and *Zeuzera coffeae* may include Endangered *Manihot walkerae* in Texas. The host range for *Parlagena buxi* and *Thosea sinensis* may include the Endangered *Ziziphus celata* in Florida (USFWS, 2002). For all these reasons, the rating is High (3) for these pests.

The environmental risk rating is High (3) for the snails because all listed plant species are at-risk from these non-host specific organisms.

Table 5. Summary of the Risk Ratings for the Consequences of Introduction <sup>1</sup> .
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Pest	Climate / Host	Host Range	Dispersal Potential	Economic Impact	Environmental Impact	Consequences of Introduction
<b>ARTHROPODA</b> <b>Coleoptera</b> <i>Anomala cupripes</i> <i>Sympiezomias velatus</i>	High (3)	High (3)	High (3)	Medium (2)	High (3) Medium (2)	High (14) High (13)
<b>Homoptera</b> <i>Aleurotuberculatus hikosanensis</i> <i>Ceroplastes japonicus</i> <i>C. pseudoceriferus</i> <i>Lycorma delicatula</i> <i>Parlagena buxi</i> <i>Ricania sublimbata</i> <i>Unaspis yanonensis</i>	High (3)	High (3)	High (3)	Medium (2) High (3) High (3) Medium (2) Medium (2) High (3) High (3)	Medium (2) High (3) High (3) High (3) High (3) Medium (2) Low (1)	High (13) High (15) High (15) High (14) High (14) High (14) High (13)
<b>Lepidoptera</b> <i>Ascotis selenaria</i> <i>Clania minuscula</i> <i>Cryptothoelea variegata</i> <i>Pryeria sinica</i> <i>Thosea sinensis</i> <i>Zeuzera coffeae</i>	High (3)	High (3) High (3) High (3) High (3) Low (1) High (3)	High (3)	High (3)	Medium (2) High (3) High (3) Medium (2) High (3) High (3)	High (14) High (15) High (15) High (14) High (13) High (15)
<b>Orthoptera</b> <i>Tridactylus japonicus</i>	High (3)	High (3)	High (3)	High (3)	Medium (2)	High (14)
<b>MOLLUSCA</b> <i>Acusta ravida</i> <i>Succinea horticola</i>	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
<b>FUNGI</b> <i>Guignardia miribelii</i> <i>Macrophoma ehretia</i> <i>Meliola buxicola</i> <i>Puccinia buxi</i>	High (3)	Low (1) Medium (2) Low (1) Low (1)	Medium (2) Medium (2) Medium (2) High (3)	Medium (2)	Medium (2)	Medium (10) Medium (11) Medium (10) Medium (11)

<sup>1</sup> Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms within that taxa for that risk element.

### Likelihood of Introduction

The Likelihood of Introduction for a pest is rated relative to six factors (APHIS, 2000). The assessment rates five of these areas based on the biological features exhibited by the pest-s interaction with the commodity. These areas represent a series of independent events that must all take place before a pest outbreak occurs. These five areas are: the availability of post-harvest treatments, whether the pest can survive through the interval of normal shipping procedures, whether the pest can be detected during a port of entry inspection, the likelihood that the pest will be imported or subsequently moved into a suitable environment, and the likelihood that the pest will come into contact with suitable hosts. The value for the Likelihood of Introduction is the sum of the ratings for the Quantity Imported Annually and these biologically based areas

(Table 6). The following scale is used to interpret this total: Low is 6-9 points, Medium is 10-14 points and High is 15-18 points.

#### Risk Element 6, subelement 1: Quantity Imported Annually

The rating for this risk element is based on the amount reported by the country of proposed export converted into standard units of 40-foot long shipping containers (APHIS, 2000). The quantity of *Buxus* to be shipped annually from China is projected to fill ten to one-hundred 40-foot shipping containers. However, permission to import into the United States may be linked with an increase in production in the future. For this reason, this element is rated as Medium (2).

#### Risk Element 6, subelement 2: Survive Postharvest Treatment

Whole trees are not likely to receive postharvest treatments such as irradiation, methyl bromide, or steam sterilization because there is no harvest of the commodity, and the types of treatments that would kill pests are also likely to kill the trees. The presence of artificial media and/or pots requires specific testing to ensure the efficacy of any proposed post-harvest treatments (Paull and Armstrong, 1994). For this reason, all of the pests are rated High (3) except for *Lycorma delicatula*. This planthopper is an active insect that is likely to jump from the host plants when disturbed (Borror *et al.*, 1989). Because it is unlikely to remain with the dwarfed trees during packing for shipment and movement of the plants it is rated Low (1).

#### Risk Element 6, subelement 3: Survive Shipment

This sub-element evaluates the mortality of the pest population during shipment of the commodity. Shipments of *B. sinica* are not likely to be refrigerated and may spend two to four weeks in maritime transit to the United States (Cargo Systems, 2001; AQIM, 2002). Direct air shipments will not take this long. Interceptions of live organisms by PPQ of the various pests (on any host) is evidence that these pests can survive the ambient transport conditions (PIN 309, 2003).

The insect pests are highly likely to survive these conditions but could be killed by exposure to below-freezing temperatures if it exceeds a species-specific duration (CPC, 2002; Lee and Denlinger, 1991; McKenzie, 1967; PNKTO #45, 1984; Rosen, 1990). A cold treatment of this duration may be detrimental to *B. sinica* penjing plants. The fungal pathogens *Guignardia miribelii*, *Macrophoma ehretia*, and *Puccinia buxi* also are likely to survive shipment because the host tissue provides a food source and protected site for growth (Agrios, 1997). While not in a protected site, the sooty mold *Meliola buxicola* also is likely to survive shipment because the transport conditions will not reduce or eliminate fungal spores (Agrios, 1997). For all of the pests, the rating is High (3). If these pests are not present on the plants during growth and packaging, and are prevented from entering the packages of plants during shipment, then no populations that follow the pathway, and the survivability of these pests is no longer a factor.

#### Risk Element 6, subelement 4: Not Detected at Port of Entry

In general, careful inspection for the mobile life stages of insect pests can detect them despite their small

size (Rosen, 1990). The very high number of interceptions of these pests from any country and on any commodity confirms that trained inspectors can find insect pests in shipments.

Some pests, however, are more difficult to detect. Eggs of *Ricania sublimbata* are oviposited in the xylem of the host plant (Xu and Zhong, 1988) and are not likely to be detected without destructive sampling. Larvae of *Ascotis selenaria*, when disturbed, stand nearly erect on the posterior prolegs, remain motionless and resemble small twigs (Borror *et al.*, 1989). Soil-borne life stages of *Tridactylus japonicus*, will escape detection without destructive sampling. The snails, *Acusta ravidia* and *Succinea horticola* are likely to be detected only if slime trails are present, but eggs and populations resident in the growing medium are likely to evade detection without destructive sampling (Anon., 2003; Burch, 1962; Godan, 1983; Lai, 1984). For these reasons, all of these pests are rated High (3) because they are unlikely to be detected during a port of entry inspection..

*Anomala cupripes* and *Sympiezomias velatus* are large and highly visible, but the soil-borne larvae are likely to evade detection without destructive sampling. *Aleurotuberculatus hikosanensis*, *Ceroplastes japonicus*, *C. pseudoceriferus*, *Parlagena buxi* and *Unaspis yanonensis*, may escape detection at low population levels due to their cryptic nature (Borror *et al.*, 1989; Rosen, 1990). The remaining insect pests, *Lycorma delicatula*, *Clania minuscula*, *Cryptothelea variegata*, *Pryeria sinica*, *Thosea sinensis*, and *Zeuzera coffeae* are members of taxa with larger sizes, and less cryptic in their habits (Borror *et al.*, 1989; Mahmood, 1976; Tang *et al.*, 1990; Zhang, 1994). The fungal pathogens produce visible foliar symptoms, but incipient infections by these fungi are not likely to be detected during a port of entry inspection. For these reasons, all these pests are rated Medium (2).

#### Risk Element 6, subelement 5: Imported or Moved To An Area Suitable for Survival

This sub-element considers the geographic location of likely markets and the chance of the commodity moving to locations suitable for the pest's survival. Plants for planting that arrive in the United States are distributed according to market demand. All of the pests are rated Medium (2) because non-cultivated, landscape and ornamental hosts are widespread throughout the United States and outdoor locations for the artificially dwarfed plants are likely to provide suitable habitats for the pests (Bailey *et al.*, 1976; NRCS, 2003).

#### Risk Element 6, subelement 6: Contact with Host Material

Lack of suitable hosts restricts the opportunities for pests to establish populations. While passive factors such as wind, water, or animals may aid in the dispersal of stages of the insect pests (Kosztarab and Kozar, 1988; Rosen, 1990), suitable hosts must be available to sustain a pest population over time. All of the pests are rated High (3) because suitable hosts grow throughout the United States. Although plants grown in indoor residential areas are likely to be widely separated from native host plant populations, they may be brought outdoors during clement weather. This close proximity of outdoor plant populations to host material provides a potential pathway for pests to become established (Beardsley and Gonzalez, 1975).

Table 6. Summary of the Risk Ratings for the Likelihood of Introduction <sup>1</sup> .							
Pest	Quantity Imported Annually	Survive postharvest treatment	Survive shipment	Not detected at port of entry	Move to a suitable habitat	Find suitable hosts	Risk Rating
<b>ARTHROPODA</b> <b>Coleoptera</b> <i>Anomala cupripes</i> <i>Sympiezomias velatus</i>	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)
<b>Homoptera</b> <i>Aleurotuberculus hikosanensis</i> <i>Ceroplastes japonicus</i> <i>C. pseudoceriferus</i> <i>Lycorma delicatula</i> <i>Parlagena buxi</i> <i>Ricania sublimbata</i> <i>Unaspis yanonensis</i>	Medium (2)	High (3) High (3) High (3) Low (1) High (3) High (3) High (3)	High (3)	Medium (2) Medium (2) Medium (2) Medium (2) Medium (2) High (3) Medium (2)	Medium (2)	High (3)	High (15) High (15) High (15) Med (13) High (15) High (16) High (15)
<b>Lepidoptera</b> <i>Ascotis selenaria</i> <i>Clania minuscula</i> <i>Cryptothelea variegata</i> <i>Pryeria sinica</i> <i>Thosea sinensis</i> <i>Zeuzera coffeae</i>	Medium (2)	High (3)	High (3)	High (3) Medium (2)  Medium (2) Medium (2) Medium (2) Medium (2)	Medium (2)	High (3)	High (16) High (15)  High (15) High (15) High (15) High (15)
<b>Orthoptera</b> <i>Tridactylus japonica</i>	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
<b>MOLLUSCA</b> <i>Acusta ravidia</i> <i>Succinea horticola</i>	Medium (2)	High (3)	High (3)	High (3)	Medium (2)	High (3)	High (16)
<b>FUNGI</b> <i>Guignardia miribelii</i> <i>Macrophoma ehretia</i> <i>Meliola buxicola</i> <i>Puccinia buxi</i>	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)

<sup>1</sup>Individual ratings are presented when there is variability within a risk element, otherwise a single rating applies to all the pest organisms for that risk element.

## F. Conclusion: Pest Risk Potential

The summation of the values for the Consequences of Introduction and the Likelihood of Introduction is the value for the Pest Risk Potential (Table 7). The following scale is used to interpret this total: Low is 11-18 points, Medium is 19-26 points and High is 27-33 points. This is an estimate of the risks associated with this importation, and reduction of risk occurs through the use of mitigation measures.

The Pest Risk Potential for all of the arthropod and mollusk pests is High, and the Pest Risk Potential

for all of the fungal pathogens is Medium. Pests with a Low Pest Risk Potential typically do not require mitigation measures other than port of arrival inspection. A value within the Medium range indicates that specific phytosanitary measures may be necessary. A rating in the High range indicates that specific phytosanitary measures, supplemental to port of arrival inspection, are strongly recommended. As a stand-alone mitigation measure for penjing plants, port of arrival inspection is insufficient to provide phytosanitary security for the quarantine pests analyzed in this document, and the development of additional specific phytosanitary measures is recommended.

Table 7. Summary of the Consequences of Introduction, the Likelihood of Introduction and Pest Risk Potential.			
Pest	Consequences of Introduction	Likelihood of Introduction	Pest Risk Potential
<b>ARTHROPODA</b>			
<b>Coleoptera</b>			
<i>Anomala cupripes</i>	High (14)	High (15)	High (29)
<i>Sympiezomias velatus</i>	High (13)	High (15)	High (28)
<b>Homoptera</b>			
<i>Aleurotuberculus hikosanensis</i>	High (13)	High (15)	High (28)
<i>Ceroplastes japonicus</i>	High (15)	High (15)	High (30)
<i>C. pseudoceriferus</i>	High (15)	High (15)	High (30)
<i>Lycorma delicatula</i>	High (14)	Med (13)	High (27)
<i>Parlagena buxi</i>	High (14)	High (15)	High (29)
<i>Ricania sublimbata</i>	High (14)	High (16)	High (30)
<i>Unaspis yanonensis</i>	High (13)	High (15)	High (28)
<b>Lepidoptera</b>			
<i>Ascotis selenaria</i>	High (14)	High (16)	High (30)
<i>Clania minuscula</i>	High (15)	High (15)	High (30)
<i>Cryptothoelea variegata</i>	High (15)	High (15)	High (30)
<i>Pryeria sinica</i>	High (14)	High (15)	High (29)
<i>Thosea sinensis</i>	High (13)	High (15)	High (28)
<i>Zeuzera coffeae</i>	High (15)	High (15)	High (30)
<b>Orthoptera</b>			
<i>Tridactylus japonicus</i>	High (14)	High (16)	High (30)
<b>MOLLUSCA</b>			
<i>Acusta ravida</i>	High (15)	High (16)	High (31)
<i>Succinea horticola</i>	High (15)	High (16)	High (31)
<b>FUNGI</b>			
<i>Guignardia miribelii</i>	Medium (10)	High (15)	Medium (25)
<i>Macrophoma ehretia</i>	Medium (11)	High (15)	Medium (26)
<i>Meliola buxicola</i>	Medium (10)	High (15)	Medium (25)
<i>Puccinia buxi</i>	Medium (11)	High (15)	Medium (26)

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